A comparison of several methods of macular hole measurement using OCT and their value in predicting anatomical and visual outcomes

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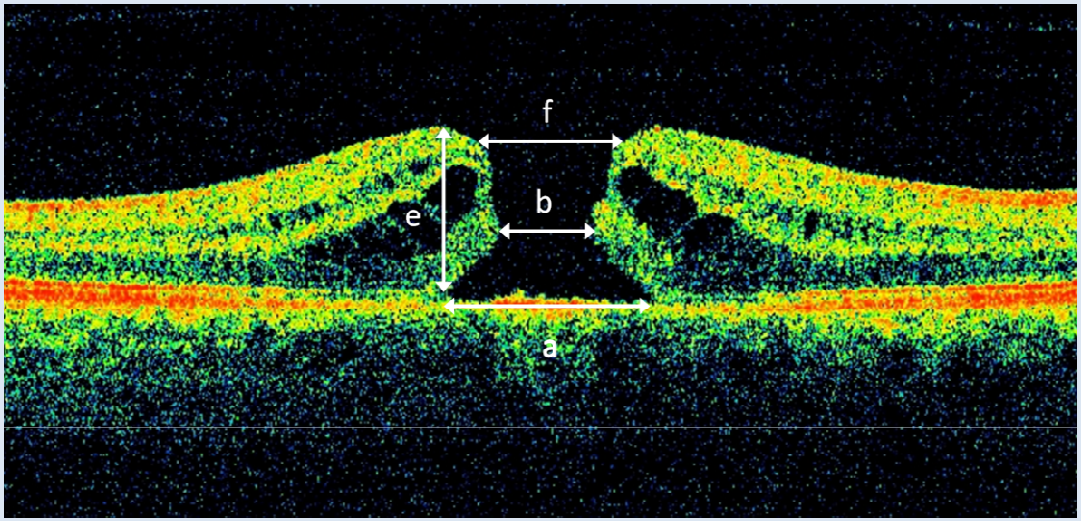
Background



a = base diameter

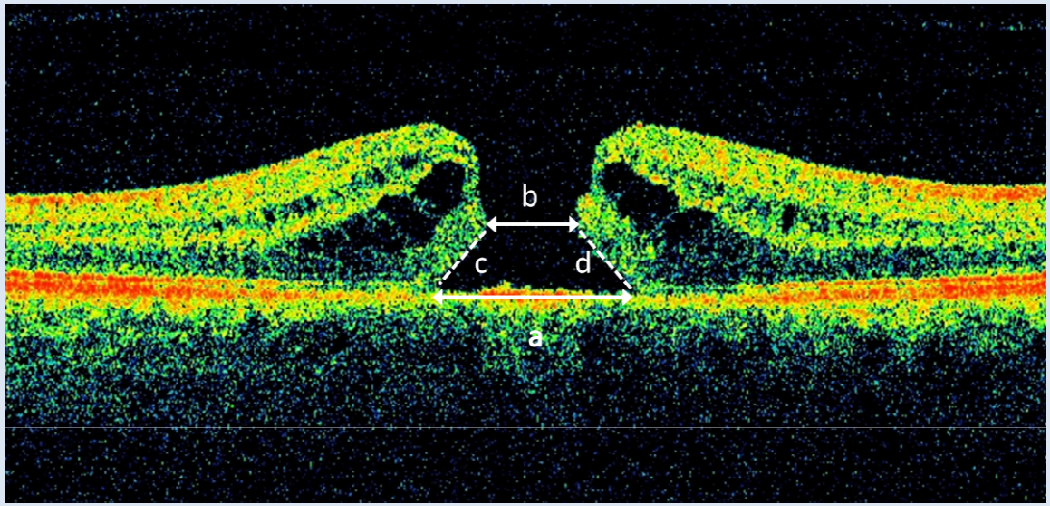
b = minimum linear dimension (MLD)[1]

e = maximal hole height

f = macular hole inner opening

1. Ip MS, Baker BJ, Duker JS, Reichel E, Baumal CR, Gangnon R, Puliafito CA. Anatomical outcomes of surgery for idiopathic macular hole as determined by optical coherence tomography. Arch Ophthalmol. 2002 Jan;120(1):29-35.

Hole Form Factor $(HFF)^2$



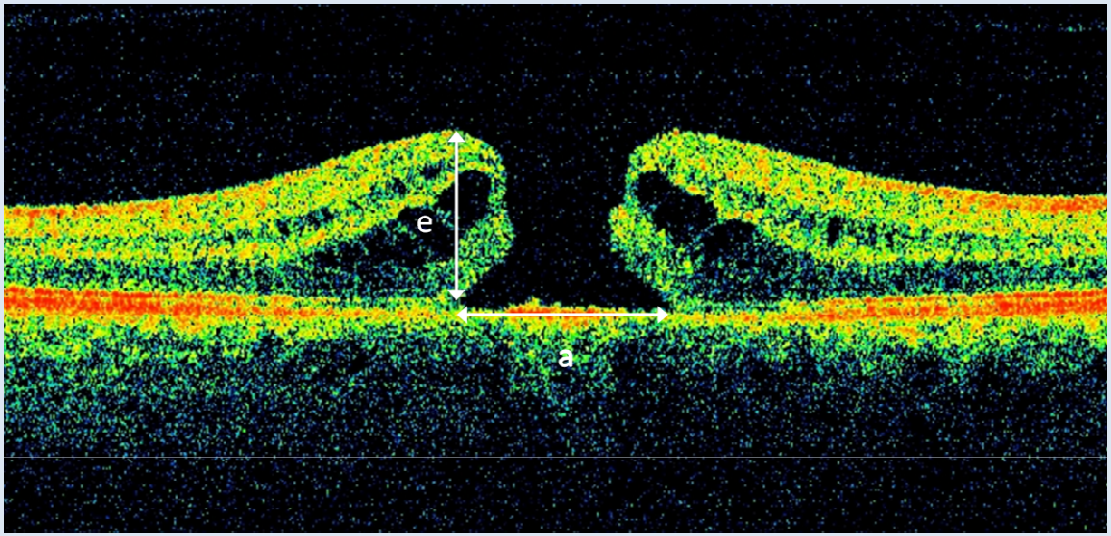
Determine extent of Base diameter (a) and MLD (b)

Hole Form Factor = (c + d) / a

No correlation found between HFF and postop gain in lines

2. Ullrich S, Haritoglou C, Gass C, Schaumberger M, Ulbig MW, Kampik A. Macular hole size as a prognostic factor in macular hole surgery. Br J Ophthalmol. 2002 Apr;86(4):390-3.

Macular Hole Index (MHI)[3]

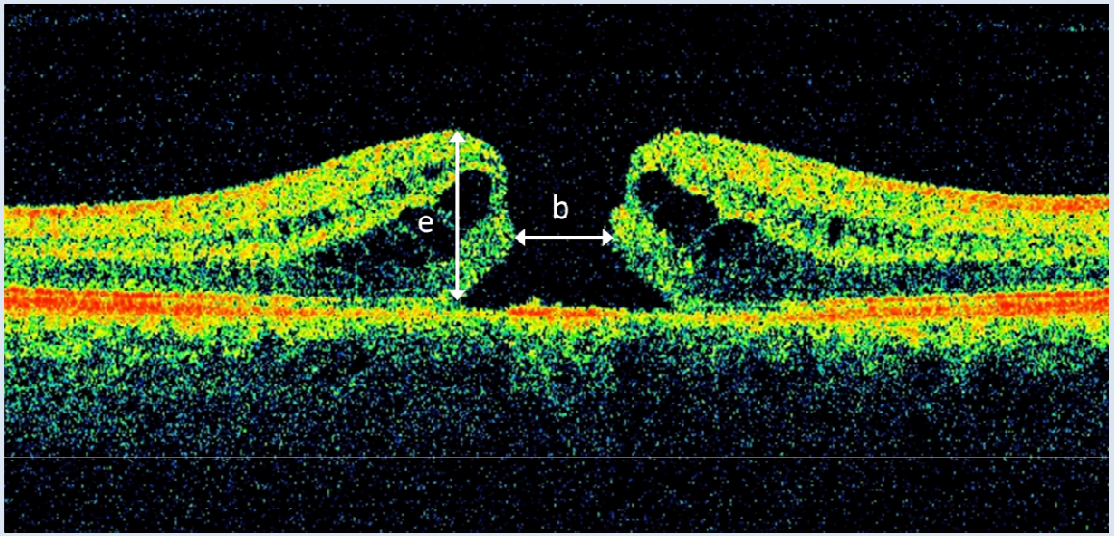


MHI = e / a

MHI was associated with postoperative vision

3. Kusuhara S, Teraoka Escaño MF, Fujii S, Nakanishi Y, Tamura Y, Nagai A, Yamamoto H, Tsukahara Y, Negi A. Prediction of postoperative visual outcome based on hole configuration by optical coherence tomography in eyes with idiopathic macular holes. Am J Ophthalmol. 2004 Nov;138(5):709-16.

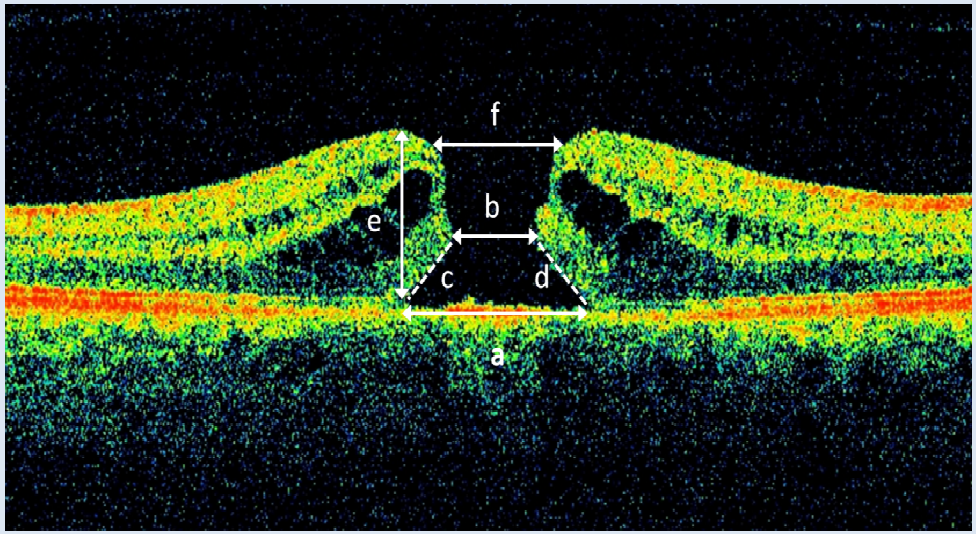
Tractional Hole Index (THI)[4]



THI = e/b

THI correlated significantly with postop vision

4. Ruiz-Moreno JM, Staicu C, Piñero DP, Montero J, Lugo F, Amat P. Optical coherence tomography predictive factors for macular hole surgery outcome. Br J Ophthalmol. 2008 May;92(5):640-4.



Basic measurements

- Base diameter (a)
- Minimum linear dimension (b)
- Hole height (e)
- Macular hole inner opening (f)

Derived indices

- Hole Form Factor (c+d/a)
- Macular Hole Index (e/a)
- Tractional Hole Index (e/b)

Study

- Prospective consecutive case series study of 50 eyes from 50 patients, May ‘09 – Jan ‘11
- Idiopathic Stage II (n=8), Stage III (n=38) or Stage IV (n=4) macular hole
- 23-gauge vitrectomy, phaco + IOL, ILM peel with Brilliant Blue G staining and endotamponade with 20% SF_6
- No special posturing
- One pseudophake, no significant cataract

Outcome measures

- Anatomical success:

  Complete circumferential hole rim reattachment without foveal neurosensory retinal defect demonstrated on OCT

- Visual success:

  Gain of two or more Snellen lines at up to a year postop

- Discharged at 3 months if 6/12 achieved, or at 1 year postop

- All patients whose macular holes had failed to close were successfully closed with further surgery

Results

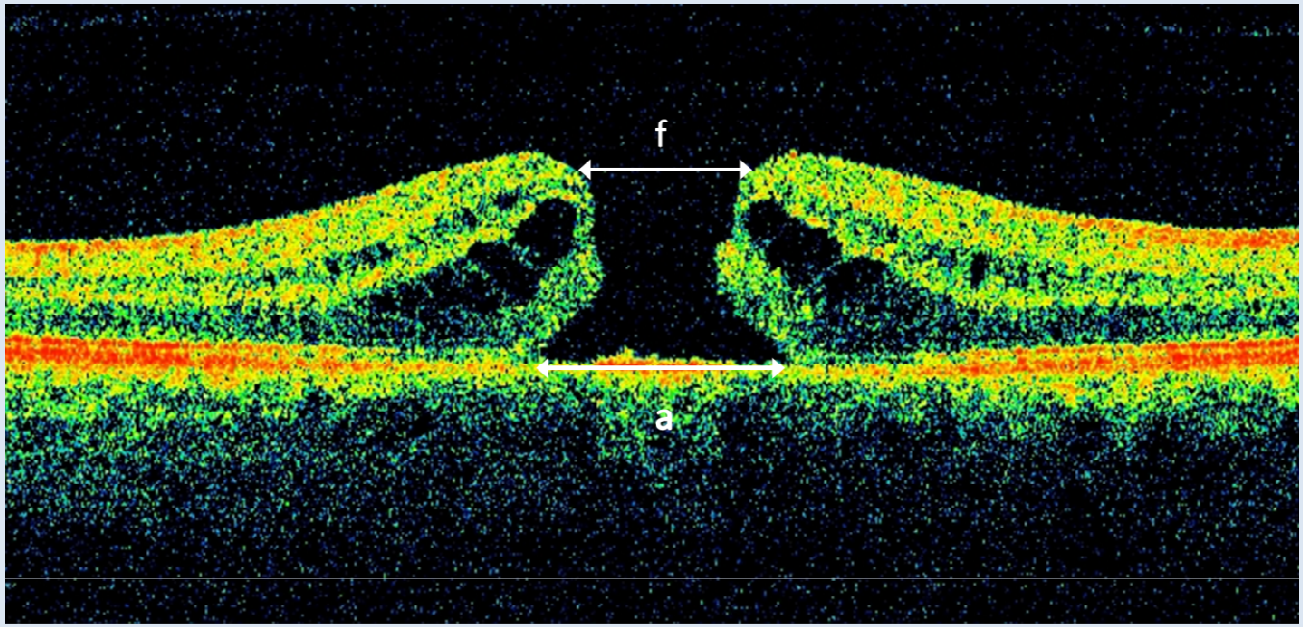
- 84% (42/50 eyes) achieved macular hole closure
- 76% (38 eyes) achieved ≥2 lines improvement in Snellen acuity
- Binary logistic regression analyses:
  - anatomical success (hole closure Y / N)
  - visual success (2 lines gained Y / N)

Assessment of variables associated with anatomical success

	Parameter	p-value	Odds ratio	95% CI for odds ratio	Area under ROC curve	95% CI for area under ROC curve
	Age	0.642	0.975	(0.877, 1.084)	0.539	(0.317, 0.760)
	Sex *Male - reference category* *Female*	0.616	0.643	(0.114, 3.610)	0.546	(0.331, 0.760)
	Axial length (mm)	0.473	0.789	(0.412, 1.510)	0.555	(0.330, 0.780)
*	**Base diameter (µm)**	**0.005**	**0.992**	**(0.987, 0.998)**	**0.929**	**(0.848, 1.000)**
*	**MH inner opening (µm)**	**0.002**	**0.984**	**(0.973, 0.994)**	**0.943**	**(0.873, 1.000)**
*	**Min Linear Dimension (µm)**	**0.002**	**0.990**	**(0.984, 0.997)**	**0.859**	**(0.735, 0.982)**
	Hole height (µm)	0.104	0.992	(0.981, 1.002)	0.679	(0.436, 0.922)
*	**Macular Hole Index**	**0.006**	**7.390[1]**	**(1.757, 31.09)[1]**	**0.909**	**(0.821, 0.998)**
	Tractional Hole Index	0.065	1.279[1]	(0.985, 1.660)[1]	0.708	(0.517, 0.899)

Assessment of variables associated with visual success

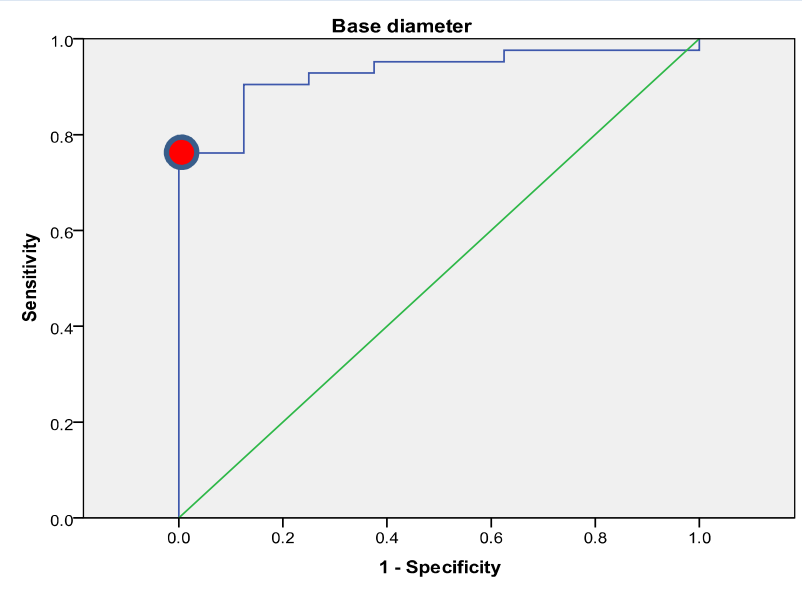
	Parameter	p-value	Odds ratio	95% CI for odds ratio	Area under ROC curve	95% CI for area under ROC curve
	Age	0.378	0.959	(0.873, 1.053)	0.565	(0.391, 0.738)
	Sex *Male - reference category* *Female*	0.954	1.042	(0.261, 4.155)	0.505	(0.314, 0.619)
	Axial length (mm)	0.703	0.892	(0.495, 1.607)	0.542	(0.359, 0.724)
*	**Base diameter (µm)**	**0.013**	**0.996**	**(0.993, 0.999)**	**0.776**	**(0.605, 0.947)**
*	**MH inner opening (µm)**	**0.013**	**0.993**	**(0.987, 0.998)**	**0.761**	**(0.591, 0.931)**
*	**Min Linear Dimension (µm)**	**0.018**	**0.994**	**(0.990, 0.999)**	**0.717**	**(0.540, 0.894)**
	Hole height (µm)	0.281	0.996	(0.998, 1.004)	0.579	(0.379, 0.779)
	Macular Hole Index	0.091	1.510	(0.937, 2.433)	0.782	(0.608, 0.955)
	Tractional Hole Index	0.178	1.130	(0.946, 1.350)	0.615	(0.437, 0.793)



a = Base diameter

f = Macular hole inner opening

Receiver Operating Characteristic (ROC) curve for anatomical success using the Base Diameter parameter



- A base diameter value of 747µm corresponds to 76.2% sensitivity and 100% specificity
- 10% reduction in the odds of anatomical success for every 13µm increase in base diameter

Thank you